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ABSTRACT

This publication contains conservation suggestions for schools in California to save water and energy. Contents include: (1) a list of sources of additional energy education assistance and materials; (2) a discussion of energy conservation in schools including HVAC system operations, lighting and building design; (3) a summary outline of actions to improve school energy efficiency; (4) a list of factors to consider in designing new schools; and (5) an outline of suggestions to conserve energy in the school transportation operations. Suggested steps to conserve water in California schools are also presented. (MR)

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Energy and Water Conservation Suggestions

for California's Elementary and Secondary Schools

CALIFORNIA STATE DEPARTMENT OF EDUCATION / Wilson Riles, Superintendent of Public Instruction
Sacramento, 1977

SE 026 352

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Contents

Preface v

I. Energy Education 1

II. Conservation of Energy in the Schools 3

Air Cooling in the Schools 3
The Impact of Building Mass 4
The Effects of Lighting 4
Control of the Heating and Cooling Systems 6
Recommendations for Swimming Pools 6
Summary of Actions to Make Existing Schools Energy Efficient 9
Factors to Consider in Designing New Schools . . . 11

III. Energy Conservation in School Transportation Systems. . 14

IV. Water Conservation 19

Steps to Take to Conserve Water Outdoors 19
Steps to Take to Conserve Water Indoors 19

Preface

For the past three years, we have witnessed an ever increasing interest in and concern about America's energy resources. The past severe winter and dwindling fuel supplies in the eastern half of the nation and California's own drought and subsequent water crisis, which have affected our supply of hydroelectric power, have brought the whole energy picture to the crisis stage.

The California State Department of Education has long been concerned about the conservation of natural resources, and it has taken several steps to provide guidance to school districts, both in regard to developing educational programs for energy conservation as part of the curriculum and in adopting programs to conserve fuels in transportation, school operations, and in facilities planning. At the same time, however, the Department and Superintendent Wilson Riles have insisted that, to the degree possible, the conservation efforts should not affect adversely the educational program. Superintendent Riles wrote of his concerns in a December, 1973, letter to all county and district school administrators:

> I firmly believe, for the sake of our children and on behalf of the State's interest in the education of those children, that it is absolutely essential that schools be maintained for at least 175 days each school year, or the equivalent. In view of this position and the existing and projected heating and motor vehicle fuel shortage, it is each school person's immediate and primary concern to take every reasonable step to conserve energy. In this respect, the responsibility rests with the ultimate consumer--the maintenance man who turns the heat on and off; the bus driver with his foot on the accelerator pedal; teachers and pupils throwing light switches; and the school administrator who must constantly evaluate activity schedules in terms of energy consumption.

The situation is even more acute today than it was in 1973, and in his Conservation Day message to school principals earlier this month, Superintendent Riles said, "... we have a responsibility to eliminate resource waste in all our operations and to help students understand the need for wise use of natural resources and control of environmental pollution. The quality of the lives they will live is very much dependent upon the quality of the physical environment and the availability of natural resources."

In his continuing effort to provide school districts with the information and help they need to develop meaningful conservation programs and practices, Mr. Riles called on three units in the Department of Education to compile their suggestions for energy and water conservation in the schools. This publication is the result of that work. The departmental units and individuals responsible for compiling the material were (1) Bureau of School Facilities Planning, James H. Orsburn, Chief; (2) Bureau of Management Services, Stanley McDougall, Field Representative, Transportation; and (3) Office of Curriculum

Services, Rudolph Schafer, Consultant, Environmental Education. We are grateful for the work they have done, and we welcome your suggestions for improving this document and for developing other materials that would be helpful to the schools in assuming the important responsibility they must assume in these critical times.

WILLIAM WHITENECK
Deputy Superintendent
for Administration

JACQUE ROSS
Chief, Division
of Administrative Services

I. Energy Education

Energy conservation has become, of necessity, a matter of great public concern in the last few years. And public school teachers, administrators, and board members have important contributions to make in this area of conservation, both in making certain that all school facilities and equipment are operated efficiently and in helping students develop the skills, knowledge, and attitudes they need to use energy resources wisely.

Energy education should not be viewed as merely another "add on" to an already crowded curriculum. Energy education should be incorporated, when it is appropriate, in the instruction in many subject areas, including science, social studies, practical arts, home economics, and mathematics.

Energy cannot exist independent of the physical environment. Therefore, instruction in energy education should include such factors as the distribution and utilization of natural resources, environmental pollution, and energy technology. The instruction should also focus on such social factors, as the effect of energy shortages on national and international politics, economics, and individual and social values. However, any energy education program should be based on certain basic concepts. New York's Dutchess County Board of Cooperative Educational Services developed the following list of basic concepts that may be of value to those who are developing an energy education program suited to their local needs:

1. Energy is so basic that nothing moves or is accomplished without it.

2. Energy is a fixed commodity, being neither created nor destroyed but converted from one form to another. The means of conversion and the by-products of this conversion are important.

3. Presently, most of our energy requirements are met through using fossil fuels. However, there are other alternative sources of energy such as solar, wind, fission, fusion, hydro, and geothermal which must be considered and developed.

4. Energy, its production, use, and conservation are essential in the maintenance of our society as we know it.

5. The production and distribution of energy have environmental, social, and aesthetic consequences.

To develop basic concepts and a course outline for an energy education program, the local school district may find it useful to seek the advice of the consultant on environmental education in the California State Department of Education, 721 Capitol Mall, Sacramento, CA 95814. Rudolph Schafer, the Department's consultant in this area, also has packets of conservation education

materials that he makes available to the schools. Additional assistance and materials are available from the following sources:

Energy and Man's Environment. John Jones, Beaverton School District, 16550 S.W. Menlo, Beaverton, OR 97005. This organization operates a comprehensive teacher training and instructional materials program in Indaho, Nevada, Oregon, Utah, and Washington. Currently, the program is not available in California, but information will be supplied on request.

ERIC/SMEAC. John Disinger, The Ohio State University, ERIC Information Center, 400 Lincoln Tower, Columbus, OH 43210. A publication, Energy Activities for the Classroom, for use in kindergarten through grade twelve is available for $4.50.

Los Angeles City Department of Water and Power. Leon Furgatch, P. O. Box 111, Los Angeles, CA 90051. Teacher kits and other information services are available on request.

National Science Teachers Association. John M. Fowler, 1742 Connecticut Avenue, NW, Washington, DC 20009. A three-volume set containing background information on energy production and conservation, teacher-pupil materials, and an extensive materials bibliography is available upon request.

Office of the San Diego County Superintendent of Schools. John Gessell, 6401 Linda Vista Road, San Diego, CA 92111. A county energy education committee that includes educators, industry representatives, and conservationists produces materials and coordinates workshops for teachers in San Diego County.

Pacific Gas and Electric Company. Dave Stewart, 77 Beale, room 1401, San Francisco, CA 94106. A well illustrated publication, Outlook '76, which contains a wide variety of information on the technical and social aspects of energy conservation, is available on request. Other materials and services are also available.

San Juan Unified School District. Randall West, 3738 Walnut Avenue, Carmichael, CA 95608. The district has developed materials for use in its schools and has conducted several teacher workshops. Information is available on request.

Southern California Edison Company. Ted Lund, P.O. Box 800, Rosemead, CA 91770. Attractive teacher kits for elementary and secondary grades and a publication on the economics of energy are available to educators in the company's service area.

II. Conservation of Energy in the Schools

A sensible energy conservation program must be developed for each of California's public schools. However, a very good program that results in the conservation of resources in one school may prove to be a very wasteful program in another. Different geographical locations, climatic conditions, and types of building construction and configuration are factors to consider in developing a program that is responsive to the needs of the community and student population being served. However, answers to several questions, such as the following, must be secured before meaningful conservation measures can be taken in any school. Does the school have air cooling, or is it mechanically ventilated? Will the construction design permit the addition of insulation, or is it necessary? What education program features may be affected if certain physical alterations are made to conserve energy?

Air Cooling in the Schools

Typically, the major problem for a classroom containing 30 or more active children is determining what to do with all the heat generated by the students and the light fixtures. If the building lacks an air cooling capability, open doors and windows will help provide the needed ventilation and thus reduce the heat generated within the classroom by children and light fixtures. Large window areas and open doors and windows create few problems until the outside temperature reaches about 21°C (70°F.). Older classrooms with high ceilings and large well shaded windows and with a good system of high/low windows with natural cross ventilation are also effective in combatting heat, and such classrooms should not be altered in most cases unless an air cooling system is added.

Solar gain, on the other hand, is almost completely undesirable in a typical school because little heat is needed as soon as the building has been warmed up in the morning. Therefore, the shading of outside walls and, most importantly, all window areas is essential in reducing the heat gain from solar rays. Providing light color reflective walls and roofing, shading the walls and roof, and providing a ventilated attic and recommended levels of insulation are methods of protecting against solar heat gain and are applicable to both air cooled and non-air cooled schools. In general, the more shading a building has, the easier it is to maintain comfortable temperatures.

When an air cooling capability is introduced in a school, certain factors become very important when the outside temperature exceeds 21°C (70°F.) and air cooling is needed. At this time the building "envelope" should not allow air to leak in or out and window area should be minimized. Proper insulation is critical in maintaining an effective cooling system. For example, double glazing, weather stripping at doors and windows, and the use of enclosed entrances, thick walls, ventilated attics, and recommended insulation in walls and attics are effective in conserving energy in an air cooling system. Having the cooperation of students and staff is especially important at times when air cooling is being provided. All outside doors and windows must be kept closed, and sources of heat must be kept to a minimum when the cooling cycle is on. (Figure 1 illustrates the ideal school configurations when certain outside weather conditions exist.)

The Impact of Building Mass

Building mass (type of construction) may have a significant impact on heating and cooling needs. In theory, the greater the building mass, the more stable the interior temperature will be.

Ideally, in winter the building mass should be warmed by the sun during the day, and the configuration and insulation systems should be designed so that some heat will be retained overnight. (See the top illustration in Figure 1.) Needed heat is released by the building mass to the classrooms by natural convection and radiation during the school day. It should be remembered, however, that a school's heating needs are minimal and may best be met by a solar heating system.

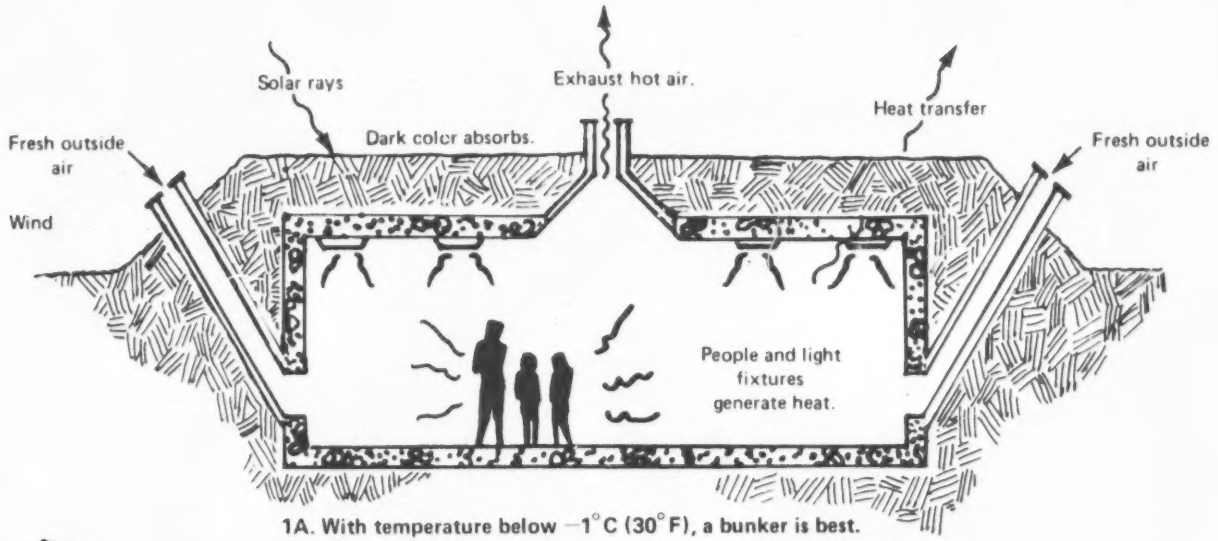
Another action that can be taken to reduce a school's energy consumption in winter is to have the custodial service performed in the mornings before school starts rather than after school closes. In this way the lights and heat turned on by the custodians would help preheat the buildings for the opening of school in the mornings, and the lights could be turned off as soon as school ends each day.

Ideally, in summer the building mass should collect the heat generated by students and light fixtures during the day and then be able to release this unwanted heat to the outside air at night. (See the bottom illustration in Figure 1.) This dumping of unwanted heat may be accomplished by natural or mechanical ventilation during the cool nighttime hours. Also, if the domestic water source is cool, then domestic water may be used to absorb heat prior to its being used for handwashing or other purposes.

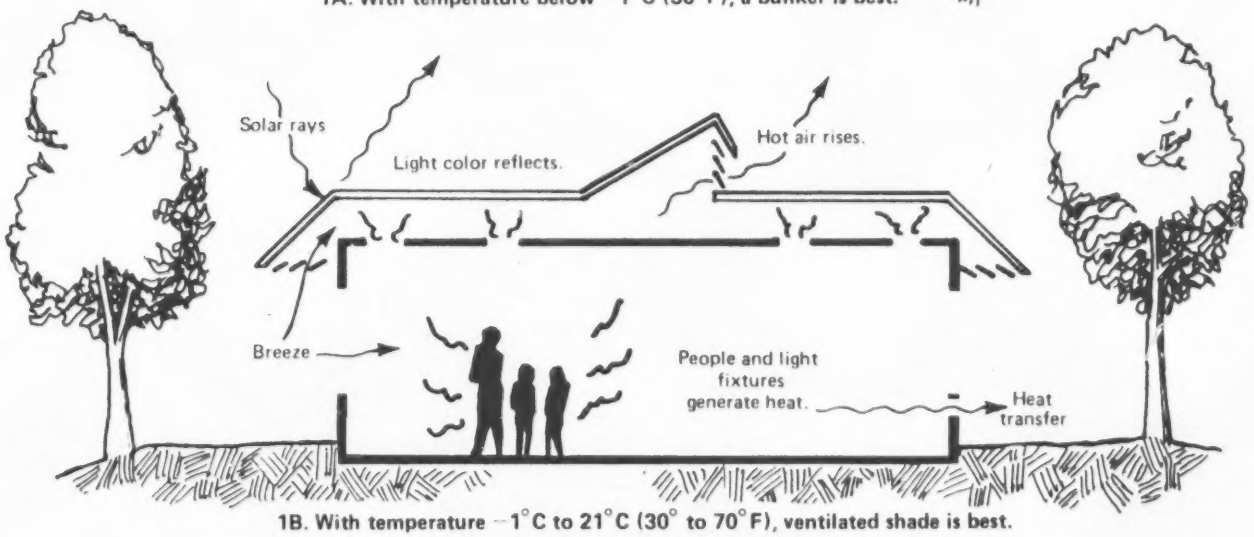
The Effects of Lighting

The best method for combatting the heat generated by lighting fixtures depends on the type of fixtures provided, their location, the configuration of the classroom, and the options for switching lights on and off. An important factor to consider in lighting is the amount of light reflected from walls, ceiling, and floors. In a room with good light reflectance factors and properly designed windows, it is possible to design a good fluorescent lighting system that requires only 21 watts of electric energy per square metre (or 2 watts per square foot) of floor area. In selecting lighting fixtures, it should be remembered that incandescent light fixtures give off much more heat for the amount of light generated than fluorescent fixtures do and thus, in general, fluorescent lighting is more desirable.

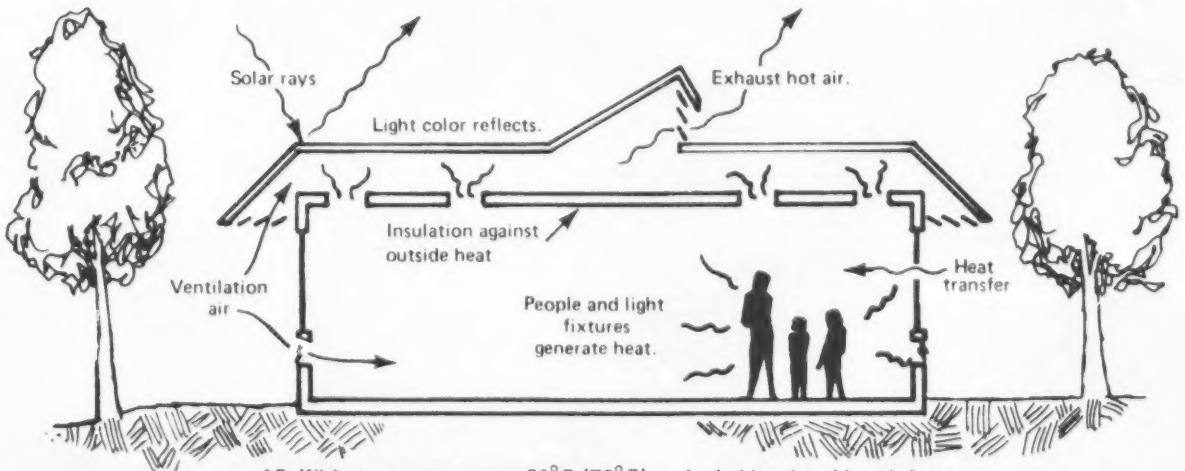
All light fixtures should certainly be turned off when an area is not occupied. Localized switches for lights in small areas are helpful in this regard. Some fixtures may be turned off when windows provide enough natural daylight. However, it is the opinion of the Department of Education at present that more is lost than gained by attempting to illuminate classrooms by the use of natural light. The additional cost for glass, the increase in heat loss or gain through outside walls, the need to provide greater shading for buildings, and, more particularly, the uneven quality and unidirectional character of the light obtained more than offset any possible savings that can be



1A. With temperature below −1°C (30°F), a bunker is best.



1B. With temperature −1°C to 21°C (30° to 70°F), ventilated shade is best.



1C. With temperature over 21°C (70°F), a shaded insulated box is best.

Fig. 1. Ideal school configurations during three different times of the year

realized through the use of sunlight. Through the proper selection of interior colors, proper ceiling heights, good lighting fixtures, and a well designed array of fixtures, it is possible to achieve superior artificial lighting with the same amount of energy that would be required in a combination of natural and artificial light.

Control of the Heating and Cooling Systems

The proper control of the heating, ventilating, and cooling systems is a major key to the sensible control of energy consumption. And the more the control is limited to a few individuals, the better the control will be.

Time clocks, two position thermostats, and inaccessible thermostats are items that may be added to an existing school's system to improve control. The heating systems should be set to heat to a maximum of 19°C (65°F.), and the cooling systems should be set to cool to a minimum of 26°C (78°F.). The time clocks should be set to turn all systems off when school is out (except, of course, at critical times, such as when heating is needed to prevent freezing). This means that the systems are turned off every night, every weekend, and every holiday. The heating systems should be turned completely off (manually) during the hot summer, and the cooling systems should be turned completely off during the cold winter if the ventilation system allows for cooling with outside air. (See figures 2 and 3 for the results of a study showing when the heating and cooling systems may be turned off completely in various locations in the state.)

It is very difficult to control the opening and closing of doors and windows when a large number of people are involved, which is especially true in a school. However, an educational program in which those involved are made aware of the consequences of their actions is certainly one step which may be taken to reduce the amount of energy that is lost by the unnecessary opening of doors and windows. The development of electric interlock systems or the use of warning lights may be another way of keeping doors and windows shut at times when heating and cooling are needed in the classroom.

To summarize, the needs, features, and problems of each school must be looked at individually. The best mechanical systems in the world will not work well from an energy conservation standpoint if they are not operated sensibly or if the design is invalidated by a lack of understanding or cooperation by those occupying the building.

Recommendations for Swimming Pools

It is recommended that each school district having heated swimming pools contact the local utility company and the city government regarding the use of natural gas for heating its pools. The following is a review of the current situation and the requirements and recommendations of the California Public Utilities Commission:

> Extensive public involvement in year-round swimming programs, activities, and other requirements has prompted the Commission to modify Decision No. 86932, which banned the use of natural gas to heat pools

▨ Months during which heat can usually be turned off

School	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Low Desert Elementary				▨	▨	▨	▨	▨	▨	▨		
High Desert Jr. High						▨	▨	▨	▨			
Northern California Inland Foothill Elementary					▨	▨	▨	▨	▨			
Southern California Inland Valley High					▨	▨	▨	▨	▨	▨		
Central California Inland Valley Middle					▨	▨	▨	▨	▨	▨		
Central California Inland Valley High					▨	▨	▨	▨	▨	▨		
Central California Inland Valley Elementary						▨	▨	▨	▨			
Central California Inland Valley Jr. High						▨	▨	▨	▨			
Central California Foothill High						▨	▨	▨	▨			
Southern California Inland Valley Middle						▨	▨	▨	▨			
Southern California Coastal High							▨	▨	▨			
Southern California Coastal Jr. High							▨	▨	▨			
Southern California Coastal Elementary							▨	▨	▨			
Central California Coastal Valley Jr. High							▨	▨	▨			
Central California Coastal Valley High							▨	▨				
Northern California Coastal Valley Elementary												
Central California High Mountain Elementary												

Fig. 2. Results of study showing months when heating system may be turned off completely in certain California schools

Months during which cooling system can usually be turned off

School	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Low Desert Elementary	■											■
High Desert Jr. High	■	■	■								■	■
Northern California Inland Foothill Elementary	■	■	■								■	■
Southern California Inland Valley High	■	■	■	■							■	■
Central California Inland Valley Middle	■	■	■	■							■	■
Central California Inland Valley High	■	■	■	■							■	■
Central California Inland Valley Elementary	■	■	■	■							■	■
Central California Inland Valley Jr. High	■	■	■	■							■	■
Central California Foothill High	■	■	■	■						■	■	■
Southern California Inland Valley Middle	■	■	■	■							■	■
Southern California Coastal High	■	■	■	■	■	■				■	■	■
Southern California Coastal Jr. High	■	■	■	■	■	■				■	■	■
Southern California Coastal Elementary	■	■	■	■	■	■				■	■	■
Central California Coastal Valley Jr. High	■	■	■	■	■					■	■	■
Central California Coastal Valley High	■	■	■	■	■					■	■	■
Northern California Coastal Valley Elementary	■	■	■	■	■	■	■	■	■	■	■	■
Central California High Mountain Elementary	■	■	■	■	■	■	■	■	■	■	■	■

Fig. 3. Results of study showing months when cooling system may be turned off completely in certain California schools

except for medical purposes. The Commission emphasized that stringent conservation of natural gas is incumbent on all of us. Also, the Commission urged that all pool owners commence arrangements to acquire pool covers and solar systems.

The section on swimming pool heating, as modified by Decision No. 87017 and dated February 23, 1977, reads as follows:

(e) Swimming pool heating

Natural gas should not be caused or permitted to be used for the purpose of swimming pool heating, except when the pool temperature is maintained at the coolest temperature compatible with pool usage and one of the following conditions is met:

(1) The pool is primarily used for educational swimming instruction, competitive swimming events, or training associated with such competitive events.

(2) The pool is primarily used for the maintenance or restoration of health pursuant to an organized or medically directed health oriented swimming program, including senior citizens or retirement community swimming programs.

(3) The pool is covered when not used for swimming.

(4) The primary source of heat is a solar heater with a standby natural gas heater.

Summary of Actions to Make Existing Schools Energy Efficient

The steps that need to be taken to make an existing school as energy efficient as possible have been explained earlier in this section and are outlined here. However, it is not feasible to make this list complete for every school in California, but the list can be used as a basic outline for schools to use in developing an outline that identifies all the steps they need to take to be energy efficient.

A. Steps for All Schools to Take

1. Shade as much of the building as possible. At the very least shade all windows from direct sunlight. If the exterior finish and aesthetics permit it, paint or otherwise finish roof and all walls exposed to sunlight with a light, highly reflective color.

2. Provide a means of exhausting hot air from all attic areas and the highest point of every major room. Provide means to exhaust light fixture heat directly to outside if possible.

3. Make sure all mechanical equipment is operating efficiently and properly.

4. Consider the addition of the following:

   a. New systems if energy savings justify it

   b. Mechanical ventilation to provide up to 1.5 m^3 (50 cfm) outside air per occupant

   c. Time clocks

   d. Two position thermostats

   e. Inaccessible thermostats

   f. Spark pilot lights

5. Consider turning the heat completely off during the summer.

6. Replace incandescent light fixtures with fluorescent light fixtures or high pressure sodium or similar highly efficient type of fixtures.

7. Consider a convenient on-off switch for lights in each room or area. And also consider reducing the size and number of lights if it is recommended by a person knowledgeable in such matters.

8. Isolate or place in outside areas appliances with especially large heat output, such as kilns. As a minimum measure, provide an exhaust fan for such appliances.

9. Insulate hot water pipes and heating ducts.

10. Provide a master turnoff valve for shower water.

B. Addition Steps to Be Taken for Schools with Air Cooling or That Are to Be Air Cooled

   1. Seal or weather strip all windows and exterior doors.

   2. Provide a method for keeping doors and windows closed when heating or cooling is taking place.

   3. Reduce glass area to amount necessary for visual relief, and replace the area with an insulated wall.

   4. Make sure all cooling equipment is operating efficiently and properly. Consider the addition of a completely new system if energy savings justify it. And consider turning the cooling system completely off during the winter and cool with outside air instead.

5. Insulate at roof, ceiling, and outside walls.

6. Insulate chilled water pipes and/or cooling ducts.

7. Have outside doors to open to vestibules if possible (provide two doors or sets of doors between inside and outside).

8. Adopt special measures appropriate to particular school.

C. Special Steps for the Staff

1. Develop an energy conscious awareness on the part of students, teachers, maintenance staff, and administrators.

2. Orient all staff members regarding equipment and systems unique to their school.

3. Maintain manuals and manufacturers' data necessary to operate and maintain equipment properly.

4. Maintain and display utility bills, showing energy consumption and costs compared to previous year's and to those of other schools.

5. Do not turn on heating, ventilating, air cooling, and lighting systems within a large area for just one or two people. Systems should not be turned on at all when a building is not occupied unless very unusual circumstances, such as freezing conditions, require it.

6. Keep in mind that light fixtures generate heat, and people generate heat. Therefore, mechanical heating is usually needed the first thing in the morning on chilly days but not at other times. If the humidity is not too great, cooling with outside air is possible until the outside temperature goes over 21°C (70°F.).

Factors to Consider in Designing New Schools

The following outline identifies most of the energy conservation factors that need to be considered by those who are designing new schools in California. However, as in the case of existing schools, it is very difficult to make a list complete for every school, but this list should serve as a good base.

A. Sources of Heat Loss or Gain That Must Be Coped with

1. Heat from occupants

2. Heat from light fixtures

3. Heat loss or gain through building "envelope" due to temperature variation

a. Roof
b. Walls

4. Solar heat gain

5. Heat loss or gain through infiltration or leakage at doors and windows

B. Methods of Coping with Heat Loss or Gain

1. Utilizing an efficient building configuration

2. Using a light colored roof

3. Shading outside walls

4. Shading the roof

5. Ventilating attics

6. Using a cool source of outside air, from basement for example

7. Using water to sprinkle roof or to cool incoming air

8. Following a sensible building orientation

9. Limiting and shading glass areas

10. Utilizing ceiling heights to meet needs of systems, high or low, depending on needs

11. Eliminating skylights or high glass

12. Using vestibules

13. Limiting number of outside doors

14. Eliminating redundant systems

15. Allowing no opposing systems

16. Maintaining control (Operable sash, for example, will not save energy if the cooling system can operate with the windows open.)

17. Employing heat recovery systems for areas of high heat demand to preheat seldom occupied areas such as auditoriums and rooms with low occupancies

18. Using time clocks

19. Using two-position thermostats

20. Exhausting heat from light fixtures directly to outside

21. Letting hot air rise by natural convection and exhausting air to outside at high point in ceiling

22. Installing fluorescent light fixtures instead of incandescent light.

New schools may be designed so that room air is exhausted directly through the light fixtures, and thus the light fixture heat need not be a problem for an air conditioning system. It all depends on the individual situation. Keep in mind that, in general, the less heat that is generated by light fixtures and added to a classroom cooling load, the less the demands will be for energy.

Those who are designing new schools should also consider the use of solar energy for domestic hot water requirements, especially if a kitchen or shower rooms are to be provided, and solar energy should also be considered for heating and possibly for cooling school buildings. If solar energy is not used, the systems provided should at least be designed for a later conversion to a solar system.

III. Energy Conservation in School Transportation Systems

Energy conservation in school transportation is of major concern in today's educational community. School buses in California travel approximately 322 million kilometres (200 million miles) annually and use 151 million litres (40 million gallons) of fuel. Available statistics indicate that if each California school bus could average 1.6 kilometres more per 3.8 litres (1 mile per gallon) than was obtained during 1975-76, over 24.5 million litres (6.5 million gallons) of fuel could be saved.

Since the energy crunch occurred, most school transportation managers have initiated efforts to reduce the amount of fuel required to operate their fleets. The possibility of running out of fuel and the rapidly escalating fuel prices are forcing school districts to take a strong stand for the conservation of fuel.

To help school districts set up energy conservation programs in their transportation departments, the Department has developed the following list of basic guidelines, which have been suggested by various transportation supervisors throughout the state. The guidelines apply to all types of transportation vehicles--driver education cars, maintenance vehicles, and school buses.

A. General Practices to Conserve Energy

1. Have one person in charge of all energy for transportation. This person will:

   a. Be in touch with local, state, and federal energy offices.

   b. Keep all forms on hand; know where, how, and when to file them; and be responsible for having them completed by the appropriate persons.

   c. Keep the various departments informed of the energy situation at all times.

2. Conduct an energy audit; begin at all places where fuel is used.

   a. The audit should be a month-by-month use for three years, with estimates for the current year. Included should be prices, suppliers, bulk storage data, delivery dates, and practices.

   b. Make certain information is accurate and specific, not general.

   c. Analyze fuel supply availability and current needs. Which months require the most gasoline or diesel fuel? Which months require the least?

d. Set up action plans for conserving fuel.

e. Set up contingencies for times when fuel is in short supply.

f. Monitor programs as devised to see if they are being carried out effectively. It must be remembered that the school which systematically identifies and evaluates its needs and supplies, highs and lows, can tailor programs more effectively and not be caught short.

B. General Considerations for the District

1. Most people are very well informed by the media on the need for and methods of conservation, and they expect the school district to exert a leadership role.

2. Major operational differences should not exist among school districts within the city or local areas. Communicate with surrounding school leaders and share program ideas.

C. Mechanical and Shop Program Conservation Actions

1. Tune and maintain engines; check plugs, points, and timing. Maintain and clean pollution controls.

2. Keep gas tanks full to avoid excessive evaporation.

3. Ensure that bus tires are properly inflated. Soft tires increase gas consumption. Inflate to maximum safe level.

4. As soon as possible replace buses that use excessive amounts of gasoline.

5. Keep gasoline tanks locked and have one person in charge of fueling of buses and other school vehicles.

6. Keep accurate bus records for maintenance and fuel consumption, oil changes, lubrication, and so forth.

7. Be sure that all oil and filter changes are made at the proper mileage level for each vehicle.

8. Maintain an inventory of all parts and supplies and order them for a full school year on a planned basis; secure the items at the best possible price.

9. In areas that have severe winter conditions, keep all buses under cover.

10. Use satellite bus parking stations at the extremities of districts to avoid "deadheading" back to a centralized bus garage.

D. Conservation Practices in Driver Training

1. Retain experienced drivers as long as possible.

2. Reeducate bus drivers regarding better fuel economy.

3. Train new drivers on existing runs while bus is "deadheading."

4. Use simulators to reduce behind-the-wheel training in vehicles.

5. Increase frequency of driver inservice training programs.

6. Train drivers to use preplanned starts and stops for less gas consumption.

7. Hold joint workshops with maintenance and driver personnel to improve operations.

8. Use an incentive system for reducing vehicle fuel consumption.

E. The Driver's Role in Energy Conservation

1. Reduce warm-up time on buses to two minutes initially and three minutes prior to starting routes. Dress warmer rather than running engines at full idle to heat the buses.

2. Drive slowly the first few miles until vehicle warms up.

3. Avoid full throttle operation.

4. Reduce speed limit to as low as practical.

5. Avoid courtesy stops.

6. Do not warm up bus early to let heaters work. Allow heater to warm during trip from garage to first stop.

F. School Bus Operations: Routing

1. Fill buses to legal capacity.

2. Reevaluate routing to make it as efficient as possible.

   a. Consider letting one bus bring children of all ages in from remote and longer runs; and use a central drop-off spot for their regular bus in town to pick them up for deposit at correct school.

   b. Stagger school hours to the extent possible to utilize buses to maximum load levels, not necessarily to grade levels.

   c. Study the possible use of computerized routing facilities, if available. Eliminate overlapping of routes if there are any, whether it is between districts, schools, or several contractors.

d. Use "zone" loading, with designated stops spaced as far apart as is feasible. Through this approach, the bus makes fewer stops to load more pupils at the most centrally located areas. (Keeping on the time schedule becomes most critical to the success of this method.)

e. Have rural students walk up to main roads for loading.

G. School Bus Operations: General

a. Have older students walk to central pick-up points.

b. Lengthen distances between pick-up points.

c. Avoid courtesy stops.

d. Plan stops on level areas instead of on inclines.

e. Consolidate loads.

f. Plan routes to make only right-hand turns to save on idling time where safety in routing permits it.

g. Consider the installations of two-way radios to direct operations and to redirect buses to avoid unnecessary use.

h. Monitor use of vehicles. Install trip recorders to record driver and vehicle operation. Use this information to reduce use of gas and oil.

i. Use the smallest practical vehicle for long distance, light-load runs.

j. Hold joint workshops with maintenance and bus driver personnel to improve operation of vehicles.

H. School Bus Operation: School Policy

a. Coordinate school calendars and start and dismissal times between elementary and secondary schools of each school system.

b. Eliminate staggered dismissal times in the same building.

c. Increase requirements for distances children must walk to school and to bus stops.

d. Overlap elementary and secondary grades and routes. Minimize staggered school schedules.

e. Eliminate trips designed for the convenience of students between school buildings.

f. Encourage pupils to ride school buses in lieu of their own motor vehicles.

g. Eliminate buses for students who are on detention.

h. Limit student parking; encourage high school pupils to ride school buses or to form car pools.

i. Develop innovations and creative programs to encourage students and staff to walk to school or ride bikes. Furnish adequate bike racks, and provide adequate security for bikes from theft and vandalism.

j. Combine school mail deliveries with bus routes.

I. School Bus Operation: Activity and Field Trips

a. Reduce or eliminate all but the most necessary athletic contests and field trips.

b. Have districts share buses when holding athletic events.

c. Establish minimum and maximum distances for field trips and athletic trips.

d. Limit field trips to full bus loads only. Consider picking up students from several schools enroute to a track meet or other event in which several schools are involved.

e. Combine athletic schedules so several sports can be played at a school at the same time; for example, baseball, tennis, and track.

f. Encourage parents to cooperate with other parents in transporting children to school for late activities and for extracurricular events. Provide professional help if additional insurance coverage is needed by parents. Help arrange for low cost premiums.

g. Contract with parents to provide transportation in remote areas.

h. Review and evaluate all security measures in the district. Make changes to take care of any increased problems resulting from the energy crisis.

IV. Water Conservation

California is in the midst of its driest year on record, and the State Department of Education and Superintendent Wilson Riles are very much concerned that all California schools do their part to conserve water. The 7,045 public schools in this state place a considerable demand on available water, and every effort should be expended to have the schools utilize the water wisely.

California has such a diverse geography that it is almost impossible to provide one list of conservation steps that the schools can take to resolve all of the problems associated with water conservation. However, if the schools will take certain common sense precautions, their actions will help greatly in reducing water consumption. Therefore, the Department has developed the following list of suggested items for school districts to consider in adopting water conservation programs in California schools:

Steps to Take to Conserve Water Outdoors

1. Check all sprinkler heads and water connections for leakage and make repairs.

2. Check directional sprinklers and pressure to determine that water falls only on turf and plants and does not overspray on sidewalks or streets.

3. Do not overwater so that run-off occurs.

4. Do not water out of habit. Analyze soil and turf to determine minimum amount and duration necessary to keep the vegetation alive.

5. Set water schedule to water only in cooler hours of the evening. Consider timing device for this purpose.

6. Do not water on windy days.

7. Do not cut grass often or short, especially in hot weather. A layer of mulch around shrubs will reduce losses of water through evaporation.

8. Do not hose off sidewalks and driveways; use brooms or sweepers to clean up debris.

9. In water districts operating under emergency rules, allow land to go unwatered or use only recycled water.

Steps to Take To Conserve Water Indoors

1. Check all faucets, drinking fountains, and other plumbing fixtures for leakage and make repairs as necessary.

2. Check that water pressure regulators are set at no more than 3.5 kg per cm^2 (50 lbs. per square inch).

3. Review automatic flushing devices and lengthen the times between flushes or go to manual flushing.

4. In water districts operating under emergency rules, it may be necessary to instruct students and staff to use fewer flushings.

5. Insulate hot water lines to reduce the running time to secure hot water.

6. Install water restrictors or low flow shower heads in showers.

7. Establish a limit to length of time necessary to allow sensible bathing.

8. Run showers only when occupied.

9. Review water consumption policies with the local water district for additional input on water conservation.

Many water utility districts have developed extensive educational aids on water conservation for incorporation in the school curriculum to convince students, and indirectly their parents, of the need for conservation. School districts are urged to make use of such free materials and teacher guides. For additional information contact Rudolph Schafer, Consultant in Environmental Education, Office of Curriculum Services, State Department of Education, 721 Capitol Mall, Sacramento, CA 95814.

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